Title: Feel the Beat

Brief Overview:

This learning unit involves gathering, plotting, and analyzing various data. The students will practice these skills both cooperatively and individually. Students will be able to gather data by taking their own pulses and to display it using a stem-and-leaf plot. Students also will analyze and interpret the data.

NCTM 2000 Principles for School Mathematics:

- **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*
- **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*
- **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*
- **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*
- **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*
- **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

Links to NCTM 2000 Standards:

- **Content Standards**

Number and Operations
Students will understand numbers, ways of representing numbers, relationships among numbers, and number systems by placing numbers in the correct ordinal position on line plots and stem-and-leaf plots.

Algebra
Students will understand various types of patterns and functional relationships, use symbolic forms, use mathematical models and analyze change in both real and abstract contexts by collecting and comparing data.

Geometry
Students will use different representational systems by constructing line plots and stem-and-leaf plots.

Measurement
Students will understand the units of seconds and minutes through the use of timing in data collection.

Data Analysis and Probability
After collecting and plotting their own data, students will pose questions and organize and interpret their data to answer those questions.

- **Process Standards**

Problem Solving
Students will develop a disposition to formulate, represent, abstract, and generalize in situations outside of mathematics by comparing pulse rates.

Communication
Students will use statistical analysis vocabulary by clearly expressing mathematical ideas to peers and teachers.

Connections
Students will recognize mathematics in contexts outside of mathematics by collecting and comparing varying pulse rate data.

Representation
Students will organize and record mathematical ideas on line plots and stem-and-leaf plots.

Links to National Science Education Standards:

- **Science as Inquiry**
  Students will develop explanations for projected theories and for actual observations through the use of data collection methods.

- **Science in Personal and Social Perspectives**
  Students will understand that some foods are nutritionally better than others are and that good nutrition and proper exercise contribute to good health.

Grade/Level:

Grades 3-5

Duration/Length:

Three to four days

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Estimating and place value
- Basic operations
- Cooperative learning
- Expressing ideas
- Bar graphs
- Basic physical exercise
- Time concepts

Student Outcomes:

Students will:

- use line plots to represent and describe data.
- use stem-and-leaf plots to compare data sets.
- predict results before gathering data.
- identify the range, mode, median, and mean of the data they collect.
- communicate findings orally and in writing.

Materials/Resources/Printed Materials:

- Construction paper
- Markers or crayons
- Rulers
- "My Favorite Foods!" survey (Student Resource #1)
- The food pyramid (Student Resource #2)
- A clock with a second hand
- Graph paper
- Post-it notes
- Tape
- Vignette (Student Resource #3)
- Animal Heart Rates Stem-and-Leaf Plot (Teacher Resource #1) – optional

Development/Procedures:

Day 1 – What Is Nutrition?

1. Distribute "My Favorite Foods!" survey (Student Resource #1) to the class.
2. Ask, "What is your favorite food?" Elicit a class discussion about favorite foods.
3. Students will complete the survey.
4. List their responses on the board.
5. Create a bar graph by putting the X- and Y-axis on the board and plotting the most popular foods on it.

6. Discuss which foods are healthy and which foods are not so healthy.
7. Divide students into groups of 3 or 4.
8. Give construction paper and markers or crayons to each group.
9. Each group will construct a bar graph showing the data represented on the group's survey.
10. Students will identify the mode as the most often occurring food (the most popular food).
11. Each group will find the mode of their data.
12. Distribute the food pyramid found on Student Resource #2.
13. Groups will write the name of the food that they determined as the mode in its proper place on the food pyramid. (It may fit into more than one category.)
14. Discuss the food pyramid and ask the students if they think the food that they chose is healthy or not so healthy, and if they should eat it all the time or only occasionally.

Day 2 – Stem-and-Leaf Plots

1. Review yesterday's lesson. "We talked about eating healthy yesterday. Why is this important?"
2. Ask, "What else makes you healthy?" Lead into the topic of exercise.
3. Discuss what happens to your body and pulse rate when you exercise.
4. Discuss what a pulse is and ask how their exercise pulse compares to their resting pulse. Remind students that in order to determine how much faster the exercise pulse is than the resting pulse, we must first determine the resting pulse.
5. Teach students how to take their pulse from their carotid artery.
6. Discuss how long they will have to count their pulses in order to figure out their resting pulse rate per minute. Accept student suggestions that are between 10 and 30 seconds. Discuss what the multiplier should be to make the pulse rate per minute. (Example: Take pulse for 20 seconds and multiply by 3 to find pulse for 1 minute or 60 seconds.)
7. Group students into pairs.
8. Have students time each other while they take their own pulses.
9. Students will take their resting pulses three times and record the data.
10. Students will identify the median of their data.
11. Discuss with students why they took their pulses three times and then chose the median time. (Because they get a more accurate reading that way than just doing it once.)
12. Talk with the class about their results and figure out what the upper extreme and lower extreme of the data is.
13. Put a line plot on the board, from the lower extreme to the upper extreme of the data, and have the students come up and mark an X over their own pulse rate.
14. Discuss the concepts of range, mode, median, and mean as they relate to this data. Include in your discussion the concept of the shape of the data and distribution of (clusters, gaps).
15. Leave the data on the board for tomorrow.

Day 3 - It's Time to Exercise!

1. Briefly review the data from the pulse activity.
2. Demonstrate construction of a stem-and-leaf plot.
3. Put a stem-and-leaf plot on the board next to the line plot with the same data.
4. Demonstrate how much easier it is to see the clusters with the stem and leaf plot. (When the range is so large, a line plot will be too long).
5. Review how to locate the carotid artery and pulse.
6. Group students into pairs.
7. Have students time each other taking their resting pulses again. They will record their data.
8. Have the students choose what kind of exercise they wish to do (jogging in place, hopping on one foot, or sit-ups, etc.).
9. Discuss how long students would like to exercise (1-3 minutes is adequate).
10. Students will spread out with their partners so that they will have space to do their exercises.
11. Students will time each other exercising and take their pulses. Students should take the pulses immediately after exercising for 10 seconds only and multiply that number by 6. Students should have a practice turn with this step before recording the data.
12. Students will go back to their seats.
13. Have students record their exercise pulse rates on post-it notes.
14. Talk to the class about their results and find the upper extreme and the lower extreme of the class data in order to determine the range.
15. Use the range of data to plot the stem of the graph on the board.
16. Students will fold their post-it notes over so that only the leaf portion of the digit is visible.
17. Students will each come up to the board and tape their numbers in the appropriate location on the stem-and-leaf plot.
18. After all the data has been placed on the stem-and-leaf plot, students will assist the teacher in arranging the data in order from the smallest to the largest.
19. Reinforce the concepts of range, mode, median, mean, clusters, gaps, and distribution by analyzing the data.

Performance Assessment:

Propose the following vignette to the students (Student Resource #3):

You are entering the annual Science Fair. This year you will analyze the pulse rates of different animals. Gather your data. Graph it on a stem-and-leaf plot. What do you notice about the data? Write a paragraph to analyze your data using these terms: mode, median, mean, range, cluster, gaps, and distribution.

Do you think bigger animals or smaller animals will have a faster pulse rate?

Do babies have faster pulse rates than third graders?

Do not forget to include a title and a key for your stem-and-leaf plot.

Discuss the performance assessment rubric with the class (Teacher Resources # 2 and 3. Make sure everyone understands the expectations and how they will be scored before they begin working.

Extension/Follow Up:

- The students can gather data on their height and weight and/or on height and shoe size and construct scatter plots to analyze for correlations.
- Students can find patterns in data and write a paragraph offering an explanation for the patterns.
- Students can collect data on pulse rates of family members and plot and analyze it.

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Student Resource #1

MY FAVORITE FOODS!

List five of your favorite foods below:

1. _____

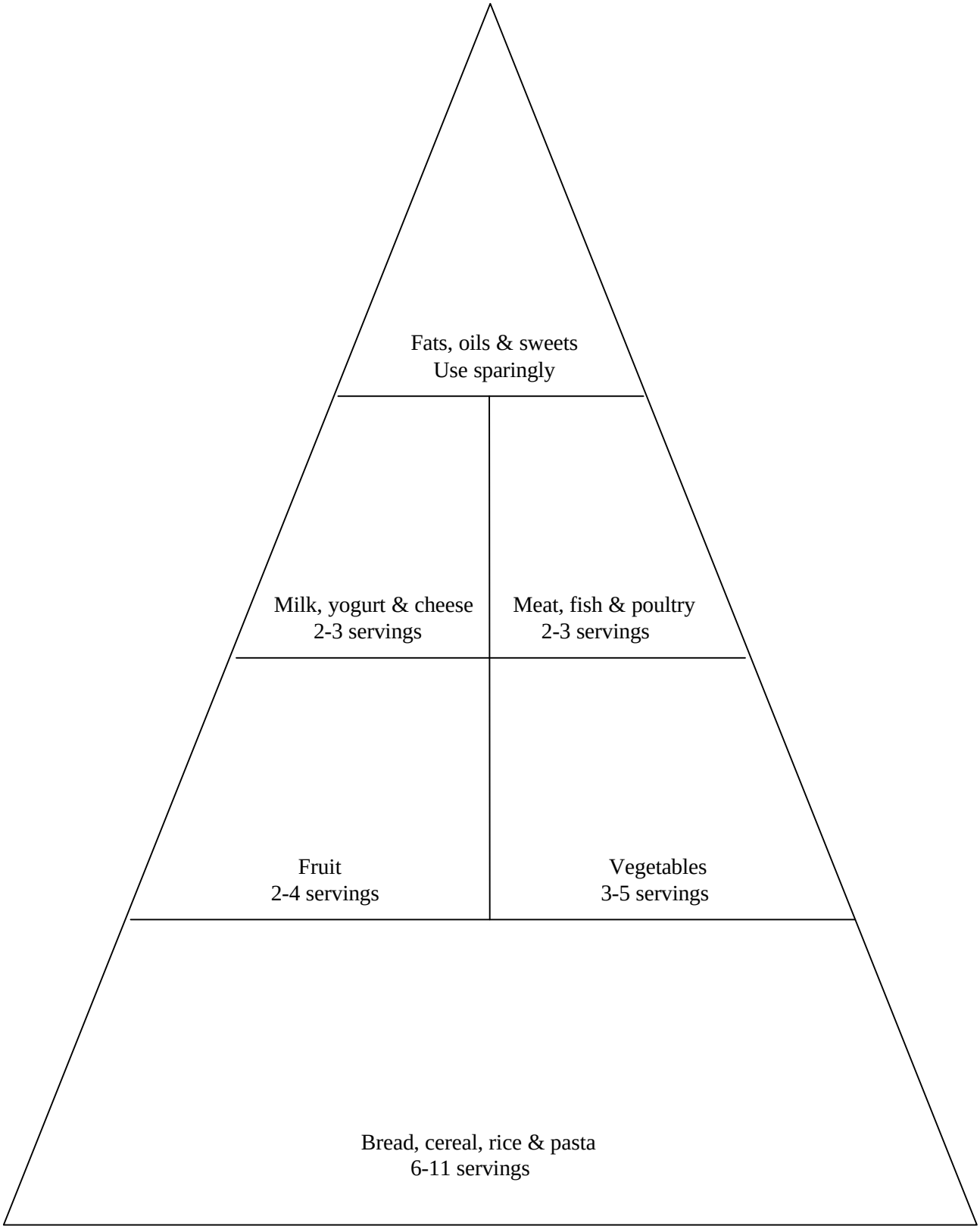
2. _____

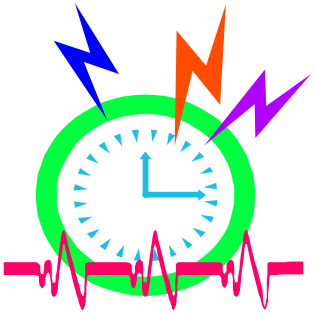
3. _____

4. _____

5. _____

Student Resource #2





VIGNETTE

You are entering the annual Science Fair. This year you will analyze the pulse rates of different animals. Gather your data. Graph it on a stem-and-leaf plot. What do you notice about the data? Write a paragraph to analyze your data using these terms: mode, median, mean, range, cluster, gaps, and distribution.

Do you think bigger animals or smaller animals will have a faster pulse rate?

Do babies have faster pulse rates than third graders?

Do not forget to include a title and a key for your stem-and-leaf plot.

ANIMAL HEART RATES STEM-AND-LEAF PLOT

1	6	Whale
2	9	Shark
3	0 5	Elephant, Horse
4	7 8	Crocodile, Frog
5	5 5	Cow, Bear
6	6	Giraffe
7	0 0 5	Human, Deer, Sheep
8	0	Goat
9	0	Small Dog
10	0	Large Dog
11	0	Dolphin
12	0 8	Kangaroo, Fish
13	0	Cat
14	0	Beaver
15	0	Rabbit
16		
17	0	Pigeon
18		
19		
20		
21	1	Turkey

Key: 1 | 6 = 16 beats per minute

SCORING RUBRIC FOR STEM-AND-LEAF PLOT

3- Placement of data is completely accurate.
Appropriate title provided.
Data displayed at equal intervals.
Key is accurate and complete.

2- Placement of data is partially accurate.
Title provided.
Data displayed at unequal intervals.
Key is partially accurate.

1- Placement of data is inaccurate.
Title is missing or inappropriate.
Key is inaccurate.

0- Blank, off-topic, or illegible response.

SCORING RUBRIC FOR PARAGRAPH

3- Correct format used.
Explanation of purpose of data using statistical vocabulary more than once.
Evidence from paragraph that data was understood.
No errors in punctuation, capitalization, spelling and usage.

2- Correct format used.
Explanation of purpose of data using statistical vocabulary once.
Evidence from paragraph that data was understood.
Few errors in punctuation, capitalization, spelling and usage.

1- Correct format used.
No explanation of purpose of data.
No use of statistical vocabulary.
Frequent errors in punctuation, capitalization, spelling and usage.

0- Little or no response.